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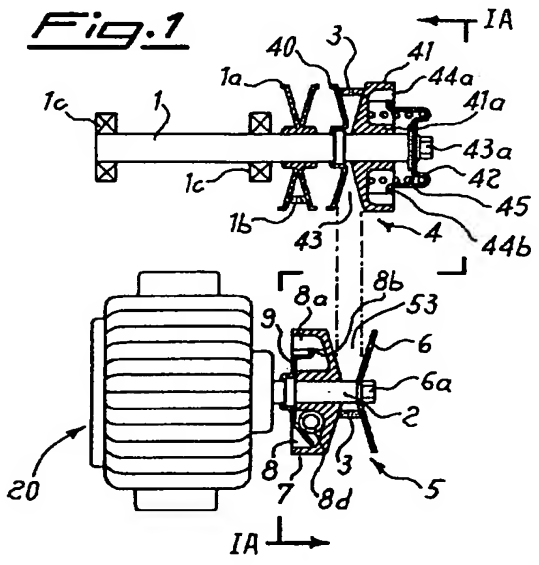
(54) Device for regulating an electric generator used in a vehicle

(57) A device for controlling and regulating an electric generator (20), such as an alternator for vehicles, the shaft (2) of which is driven by a driving shaft (1), comprises a pulley (4) on the driving shaft (1) and a pulley (5, 50, 500) on the driven shaft (2), around which pulleys a belt (3) is endlessly mounted, the pulleys (4; 5, 50, 500) respectively consisting of two opposite half-pulleys (40, 41; 6, 7; 60, 70; 600, 700) which are locked in rotation with respect to the associated shafts and the relative distance of which in the axial direction varies automatically according to the speed of rotation of the driving shaft (1).

Fig.1



EP 0 993 098 A2

Description

[0001] The present invention relates to a control and regulating device for electric generators in vehicles with an internal-combustion engine.

[0002] Owing to the special nature of the performance which is required of electric generators - namely dynamo and alternator - in vehicles, said generators must have features which are substantially different from those used in fixed installations. In fact, whereas in the latter case a generator may be operated with a practically constant speed of rotation of the rotor, in vehicles which are propelled by an internal-combustion engine and in which the electric generator is directly or indirectly connected to the crankshaft, the speed of rotation of its rotor is subject to continuous variations corresponding to the variations in the speed of the vehicle engine, thereby resulting in a variation in the current output and efficiency of the alternator.

[0003] The transmission ratio between crankshaft and electric generator is generally chosen so that, at low engine speeds, the generator is able to supply sufficient current to satisfy the normal requirement, which includes recharging the battery.

[0004] Since, in recent years, the electrical energy requirement in vehicles has increased and continues to increase owing to the increased use of auxiliary utility devices installed in them, the battery of the vehicle tends, at low engine speeds, to become discharged owing to insufficient recharging by the alternator.

[0005] The present technology solves these problems by increasing the transmission ratio between crankshaft and current generator so as to maintain in all cases a high speed of rotation of the latter.

[0006] This increase in the transmission ratio, which is maintained also when there is an increase in the number of revs of the crankshaft, has the disadvantage, however, of causing the current generator to operate in low efficiency zones corresponding to high rpm ranges of the engine.

[0007] The technical problem which is posed, therefore, is that of providing a device for controlling and regulating current generators in vehicles with an internal-combustion engine, which is designed to ensure operation of the generator with a high current output and high overall efficiency, independently of the speed of the vehicle engine.

[0008] These technical problems are solved according to the present invention by a device for controlling and regulating an electric generator, such as an alternator for vehicles, in which the shaft of the electric generator is driven via a flexible friction-member transmission by a driving shaft, such as the crankshaft of an internal-combustion engine of a vehicle or a shaft connected thereto, and comprises a pulley on the driving shaft and a pulley on the driven shaft, around which pulleys a transmission belt is wound, each pulley respectively consisting of two opposite half-pulleys which are locked in rotation with respect to the associated shafts and the relative axial distance of which varies automatically according to the variations in speed of the driving shaft.

[0009] Further characteristic features and advantages of the present invention will emerge more clearly from the following detailed description, provided solely by way of a non-limiting example, of embodiments thereof, with reference to the accompanying drawings, in which:

- Figure 1 shows a partial cross-section, along the respective planes indicated by I-I in Fig. 1a, of a first embodiment of the control and regulating device for electric generators according to the invention in conditions where the engine is running at a low number of revs;
- Figure 1a shows a front view of the device according to Fig. 1, partially sectioned along the plane indicated by IA-IA;
- Figure 2 shows a cross-section similar to that of Fig. 1 in conditions where the engine is running at a medium number of revs;
- Figure 3 shows a cross-section similar to that of Fig. 1 in conditions where the engine is running at a high number of revs;
- Figure 4 shows a partial cross-section, along the respective planes indicated by IV-IV in Fig. 4a, of a second embodiment of the device according to the invention when the engine is running at a low number of revs;
- Figure 4a shows a front view of the device according to Fig. 4, partially sectioned along the plane indicated by IVA-IVA;
- Figure 5 shows a cross-section similar to that of Fig. 4 in conditions where the engine is running at a medium number of revs;
- Figure 6 shows a cross-section similar to that of Fig. 4 where the engine is running at a high number of revs;
- Figure 7 shows a partial cross-section, along the respective planes indicated by VII-VII in Fig. 7a, of a third embodiment of the device according to the invention in conditions where the engine is running at a low number of revs;
- Figure 7a shows a front view of the device according to Fig. 7, partially sectioned along the plane indicated by VIIA-VIIA;
- Figure 8 shows a cross-section similar to that of Fig. 7 in conditions where the engine is running at a medium number of revs; and

- Figure 9 shows a cross-section similar to that of Fig. 7 in conditions where the engine is running at a high number of revs.

[0010] With reference to the abovementioned Figures, the device for controlling and regulating an electric generator according to the invention is arranged between a driving shaft 1, which is supported by means of bearings 1c and moved by the shaft of an internal-combustion engine (not shown) for vehicles by means of a pulley 1a keyed onto the shaft 1 itself and an associated belt 1b, and a driven shaft 2 of an electric generator 20, such as an alternator, used in a vehicle.

[0011] The driving shaft 1 essentially consists of a counter-shaft of the crankshaft, but could also consist of the latter or of a gear transmission or the like.

[0012] This driving shaft or counter-shaft 1 has the function of increasing the speed of rotation of the shaft 2 of the generator with respect to the speed of rotation of the crankshaft.

[0013] The transmission between the driving shaft 1 and the driven shaft 2 is provided by means of the device according to the invention which is essentially formed by a V-belt which is endlessly wound onto two pulleys which are keyed onto the respective shaft and each of which consists of two opposite half-pulleys, the relative distance of which varies automatically according to the speed of the driving shaft, as will be explained in greater detail below.

[0014] In particular, with reference to the Figures, a pulley 4 of a driving shaft 1 comprises a fixed conical half-pulley 40, for example force-fitted onto the driving shaft 1 on a circumferential shoulder thereof and a conico-cylindrical half-pulley 41 mounted on the shaft by means of its hub portion 41a and axially movable with respect to the fixed half-pulley 40. The movable half-pulley 41 is fastened onto the driving shaft 1 so as not to be able to rotate with respect thereto. This is achieved by a creating a connection system consisting of splined profiles 44a, 44b between the conico-cylindrical half-pulley 41 and a flange 42 rigidly connected to the driving shaft 1 by means of an end screw 43a. The splined profiles are correspondingly formed on the periphery of the flange 42 and on the internal diameter of the cylindrical portion of the movable half-pulley 41. The flange 42, which is bell-shaped, acts as an axial-sliding guide for the movable half-pulley 41 and as a seat for a helical spring 45 which is mounted coaxially with the driving shaft 1 and has its ends arranged between the flange 42 and the movable half-pulley 41 so as to oppose the movement of the latter away from the fixed half-pulley 40.

[0015] In a first embodiment of the invention illustrated in Figures 1 to 3, a pulley 5 on a driven shaft 2 comprises a fixed conical half-pulley 6 keyed onto the driven shaft 2 by means of a nut 6a and a conical half-pulley 7 axially movable with respect to the fixed half-pulley 6, so as to form a groove 53 of variable width in the axial direction. The movable half-pulley 7 may in fact be made of plastic. The movable half-pulley 7 is fastened onto the driven shaft 2 so as not to be able to rotate with respect thereto. For this purpose the half-pulley 5 has a conico-cylindrical shape and, in its cylindrical portion, opposite to the fixed conical half-pulley 6, has a cavity 8 provided peripherally with projections 8a and intended to engage slidably with the corresponding splined profile 8b of a flange 9 rigidly connected to the driven shaft 2, for example welded to a thicker portion thereof.

[0016] As shown in Figure 1a, the cavity 8 has several radial-travel tracks 8c for at least one pair of centrifugal masses 8d which are designed to come into contact with the flange 9 so as to cause the movement, away from it, of the movable half-pulley 7 and therefore its movement towards the fixed half-pulley 6.

[0017] In the first embodiment shown in Figures 1 to 3 the centrifugal masses 8b have a cylindrical - optionally hollow - shape and therefore a circular cross-section designed to interact with the flange 9.

[0018] Using similar numbers for similar or identical parts, in a second embodiment of the invention illustrated in Figures 4 to 6, a pulley 50 on a driven shaft 2 comprises a fixed conical half-pulley 60 which is keyed onto the driven shaft 2 by means of a nut 60a and a conical half-pulley 70 which is axially movable with respect to the fixed half-pulley 60.

[0019] Also, the pulley 50 has a conico-cylindrical shape and, in its cylindrical portion opposite to the fixed conical half-pulley 60, has a cavity 80 similarly slidable with splined profiles 80a, 80b, as in the first embodiment.

[0020] As shown in Figure 4a, the cavity 80 has several radial-travel tracks 80c for at least one pair of centrifugal masses 80d which are intended to come into contact with the flange 9 so as to cause the movement, away from it, of the movable half-pulley 70 and therefore its movement towards the fixed half-pulley 60.

[0021] In the second embodiment according to Figures 4 to 6, the centrifugal masses 80d have a spherical shape for interacting with the flange 90 formed in a manner similar to that of the flange 9 of the first embodiment.

[0022] In a third embodiment of the invention illustrated in Figures 7 to 9, a pulley 500 on a driven shaft comprises a fixed conical half-pulley 600 which is keyed onto the driven shaft 2 and a conical half-pulley 700 which is axially movable with respect to the fixed half-pulley 600.

[0023] Also, the pulley 500 has a conico-cylindrical shape and, in its cylindrical portion, opposite to the fixed conical half-pulley 600, has a cavity 800 similarly slidable with splined profiles 800a, 800b, as in the first embodiment.

[0024] As shown in Figure 7a, the cavity 800 has several radial-travel tracks 800c for at least one pair of centrifugal masses 800d intended to come into contact with the flange 900 so as to cause the movement, away from it, of the mov-

able half-pulley 700 and therefore its movement towards the fixed half-pulley 600.

[0025] In the third embodiment according to Figures 7 to 9, the centrifugal masses 800d have a trapezoidal prismatic shape so as to interact with the flange 900 formed in a similar manner to the flange 9 of the first embodiment. The operating principle of the device is the same for all the embodiments described and may be summarised as follows:

[0026] When the crankshaft rotates at a low number of revs (Figures 1, 4, 7), the groove 43 of the driving-shaft pulley 4 is kept closed by the thrusting action of the helical opposition spring 45 which abuts against the flange 42 and acts against the movable half-pulley 41.

[0027] The groove 53 of the driven-shaft pulley 5, 50, 500 is in the fully open condition and the transmission ratio between driving shaft 1 and driven shaft 2 is high.

[0028] The device therefore allows the number of revs of the alternator to be increased with respect to the crankshaft, thereby increasing the current output of the generator in low speed ranges.

[0029] With an increase in the number of revs (Figures 2, 5, 7), the centrifugal force of the centrifugal masses 8d, 80d, 800d which are displaced radially far from the axis of the driven shaft 2, and reacting on the respective travel tracks, axially push the movable half-pulley 7, 70, 700 towards the fixed half-pulley 6, 60, 600, causing the groove 53 of the pulleys 5, 50, 500 to close. The V-belt 3, which is unextendable and therefore has a constant length, consequently tends to move onto larger diameters and therefore widen the groove 43 of the pulley 4 on the driving shaft, overcoming the opposing action of the helical spring 45. The transmission ratio between driving shaft 1 and driven shaft 2 is therefore gradually reduced with an increase in the number of revs of the crankshaft. The device therefore allows the number of revs of the alternator to be controlled with respect to the crankshaft, preventing the alternator from running at a needlessly high speed, but providing a high output (high rpm of the engine) and an increase in the overall efficiency of the alternator, in particular at the middle running speeds of the engine. The rigidity of the helical spring 45 and the configuration of the sliding cavity of the driven-shaft pulley are chosen so as to provide the alternator with the characteristic curve which is appropriate for the desired operation.

[0030] In particular and as may be determined from the purely exemplary table which follows, it is possible to produce operating conditions which tend to provide a substantially constant number of revolutions of the alternator in a range of revolutions of the crankshaft lying between 1400 and 4900 rpm, this corresponding also to the output of a high amperage and a high efficiency.

TABLE

Alternator (rpm)	Current (A)	Efficiency (%)	Engine (rpm)
1200	22.6	62.0	256
1500	36.4	60.9	320
2000	52.5	57.6	427
2500	61.9	55.3	534
3000	67.7	54.3	641
3500	72.8	53.8	748
4000	76.5	52.5	854
4500	80.1	52.2	961
5000	82.7	52.1	1068
5500	84.5	51.6	1175
6000	86.0	50.8	1282
6500	87.4	50.1	1368
6500	87.4	50.1	1882
6500	87.4	50.1	2376
6500	87.4	50.1	2870
6500	87.4	50.1	3364
6500	87.4	50.1	3856
6500	87.4	50.1	4352

TABLE (continued)

Alternator (rpm)	Current (A)	Efficiency (%)	Engine (rpm)
6500	87.4	50.1	4865
7000	88.1	49.1	5239
7500	89.2	48.3	5613
8000	90.0	47.7	5987
8100	90.7	46.9	6062

Claims

1. Device for controlling and regulating an electric generator (20), such as an alternator for vehicles, in which the shaft (2) of the electric generator (20) is driven by a driving shaft (1), characterized in that it comprises a pulley (4) on the driving shaft (1) and a pulley (5, 50, 500) on the driven shaft (2), around which pulleys a belt (3) is endlessly mounted, the pulleys (4; 5, 50, 500) respectively consisting of two opposite half-pulleys (40, 41; 6, 7; 60, 70; 600, 700) which are locked in rotation with respect to the associated shafts and the relative distance of which in the axial direction varies automatically according to the speed of rotation of the driving shaft (1).

2. Control and regulating device according to Claim 1, characterized in that said pulley (4) on the driving shaft (1) comprises a fixed conical pulley (40) which is keyed onto said driving shaft (1) and a conical half-pulley (41) which is axially movable with respect to said fixed half-pulley (40) against the opposing action of resilient means (45).

3. Control and regulating device according to Claim 2, characterized in that said movable half-pulley (41) on the driving shaft (1) is coupled, via splined profiles (44a, 44b), to a flange (42) rigidly connected to said driving shaft (1).

4. Control and regulating device according to Claim 2, characterized in that said flange (42) acts as a sliding guide for said movable conical half-pulley (41) and forms the seat housing said resilient means (45).

5. Control and regulating device according to Claim 4, characterized in that said resilient means consist of a spring mounted coaxially with said driving shaft (1) and with its ends abutting between said flange (42) and said movable conical half-pulley (41).

6. Control and regulating device according to Claim 1, characterized in that said movable half-pulley (7; 70; 700) on the driven shaft (2) comprises a concave seat (8; 80; 800) which is located opposite to the groove (53) of the pulley (5; 50; 500) and has radial-travel tracks (8c; 80; 800c) for centrifugal masses (8d; 80d; 800d) acting on a fixed flange (9; 90; 900) fixed onto said driven shaft (2).

7. Control and regulating device according to Claim 6, characterized in that said flange (9; 90; 900) is coupled, via splined profiles (8a, 8b; 80a, 80b; 800a, 800b), to said movable half-pulley (7; 70; 700).

8. Control and regulating device according to Claim 6, characterized in that said centrifugal masses (8d) consist of cylinders which are optionally hollow.

9. Control and regulating device according to Claim 6, characterized in that said centrifugal masses (80d) consist of spheres.

10. Control and regulating device according to Claim 6, characterized in that said centrifugal masses (800d) are prisms with a trapezoidal cross-section.

Fig.1

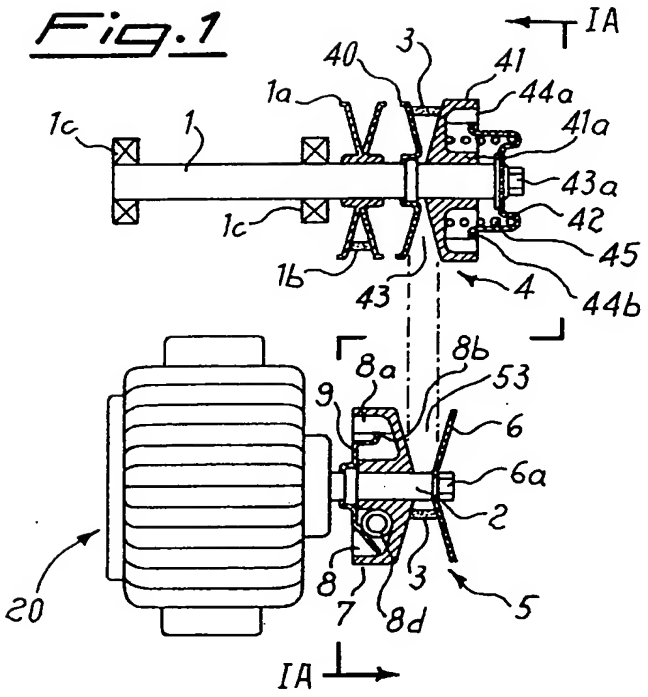


Fig.1a

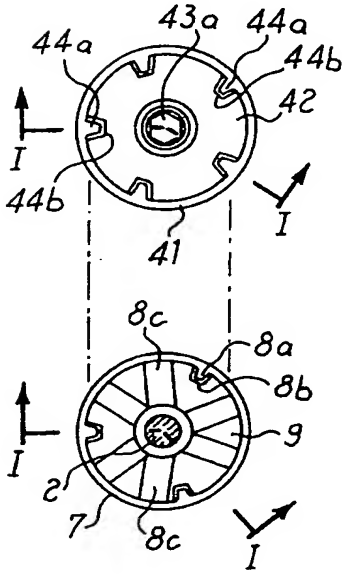


Fig.2

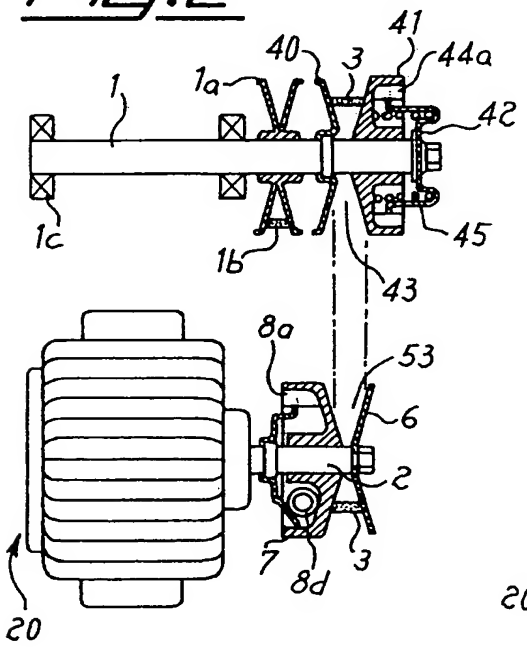


Fig.3

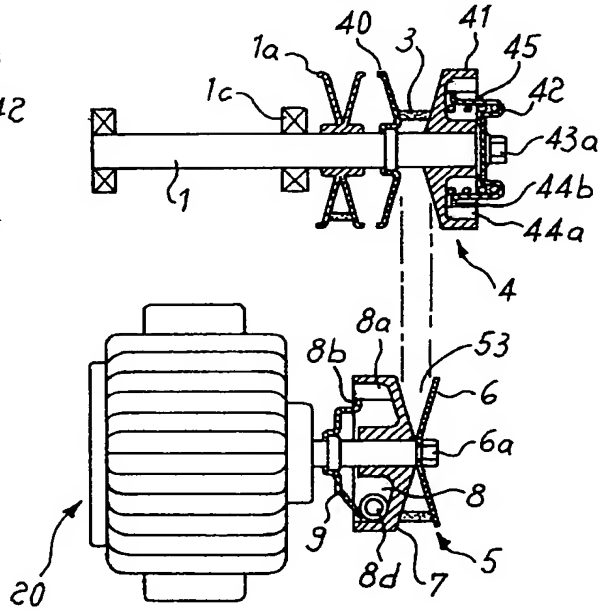


Fig.4

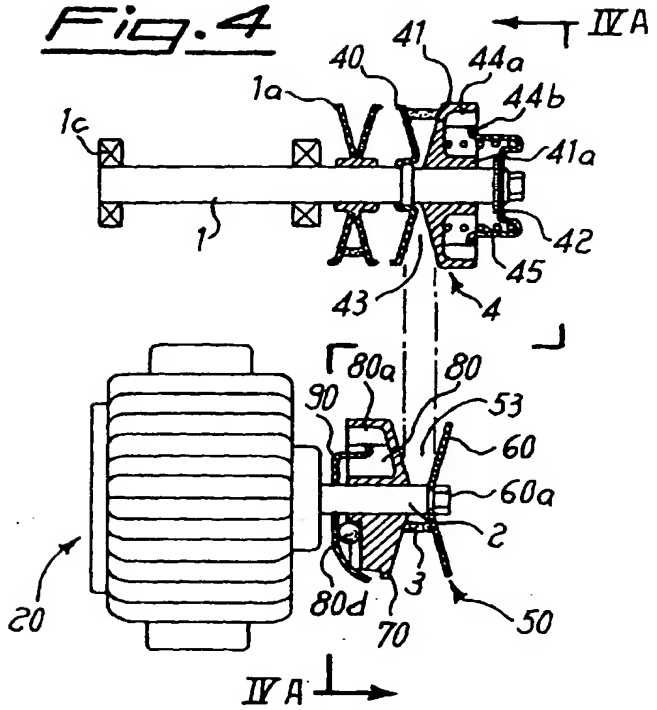


Fig.4a

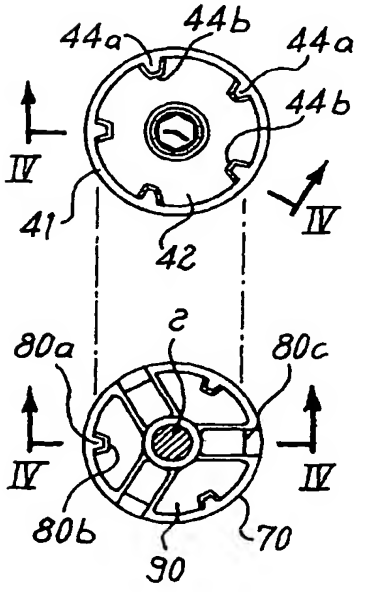


Fig.5

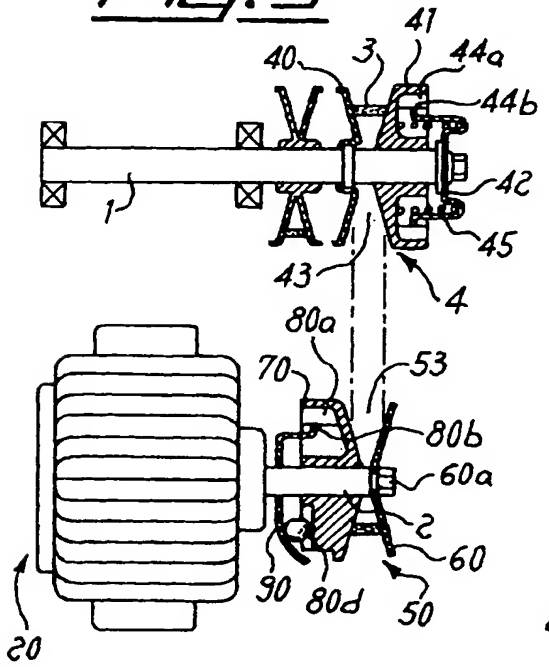


Fig.6

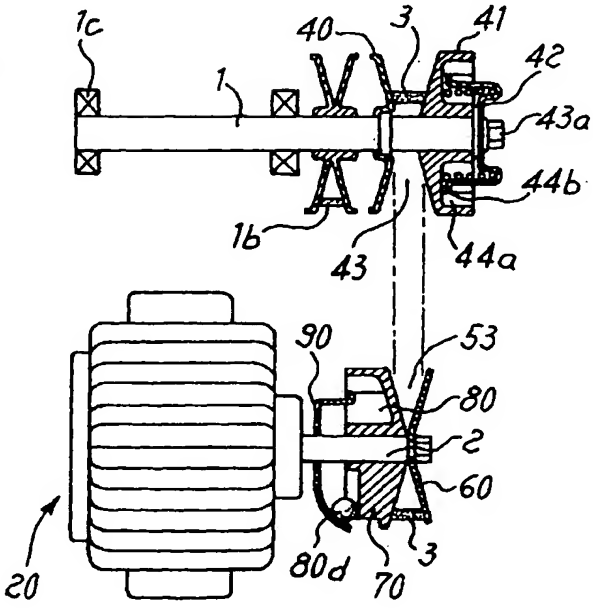


Fig.7

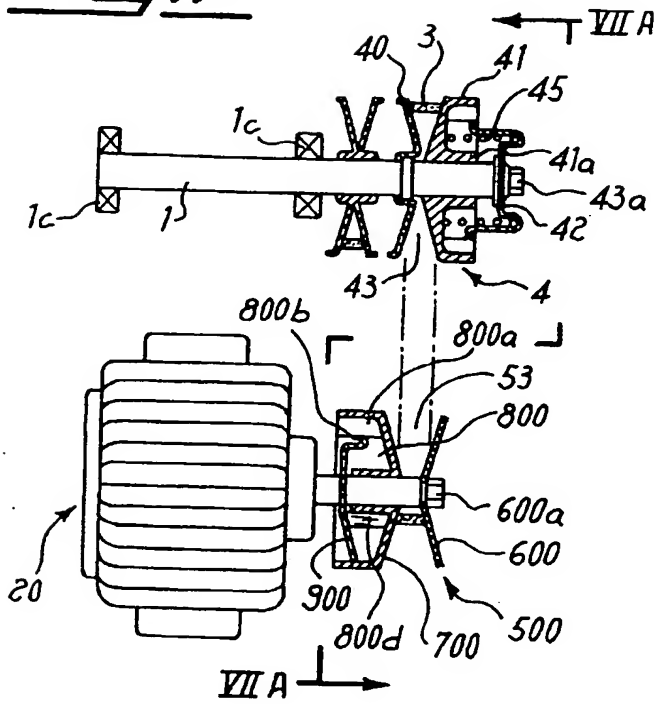


Fig.7a

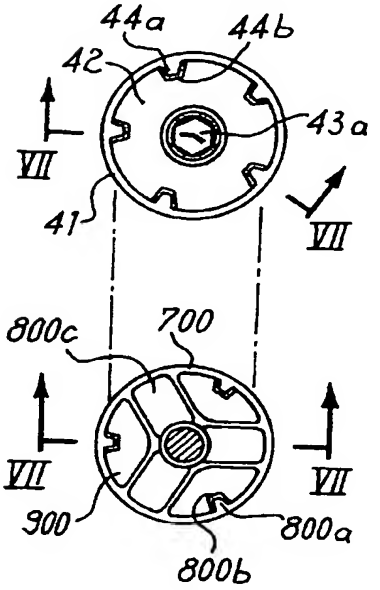


Fig.8

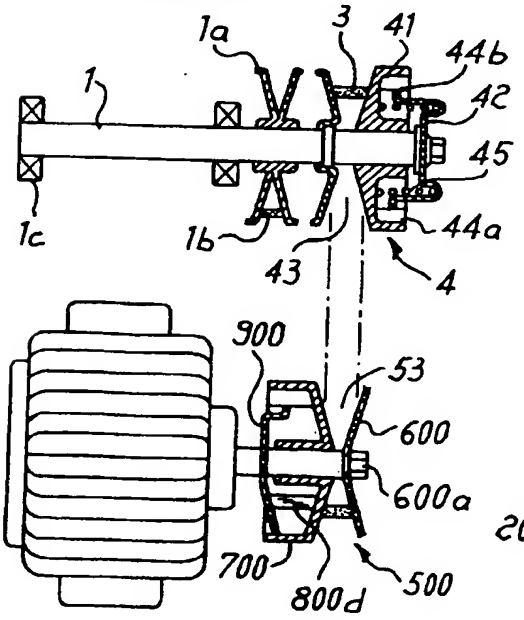
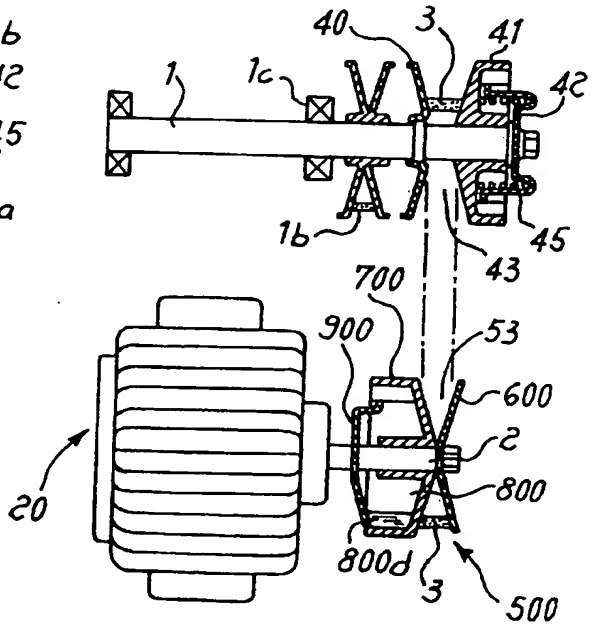


Fig.9



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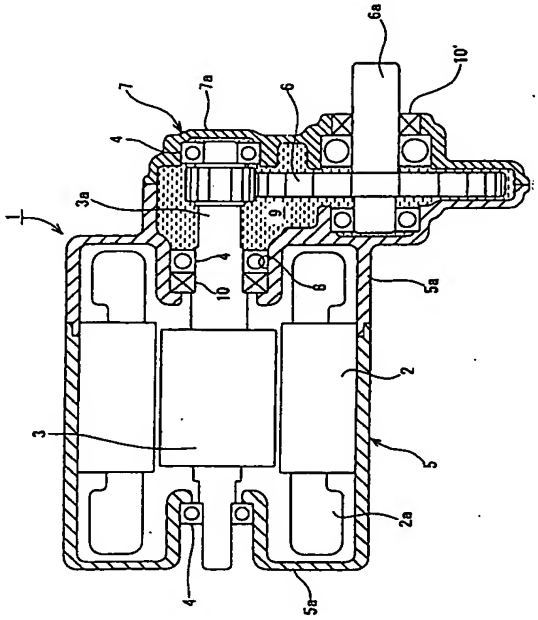
(54) MOTOR AND PRODUCTION METHOD OF MOTOR

(57) The present invention is a motor which has a motor casing (5) and a reduction gearing casing (7) integrally formed, a hole (8) formed on a portion shared by these casings, through which an output shaft (3a) of a rotor (3) extends from the motor casing side to the reduction gearing casing side, and a lubrication oil (9) filling the reduction gearing casing. And, a method for producing a motor comprises the step of charging a resin (11) into and curing it in the motor casing to adhere the resin to a coil of an armature and the inner surface of the motor casing. Besides, the motor casing (5) has a first casing member (510), a second casing member (520) and a third casing member (530) for covering a control section (4), and the first casing member is assembled with the second casing member, and the first casing member is assembled with the third casing member.

Fig. 1



EP 1 231 701 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a motor comprising an armature, a rotor and a motor casing for holding them and a method for producing the motor.

BACKGROUND ART

[0002] Generally, a DC motor or a DC brushless motor is used as a motor engine for vehicles such as electric vehicles and electric scooters. Such a type of motor includes an armature, a rotor and a motor casing for holding the armature and bearings for the rotor, and the armature and the rotor are disposed on the motor casing.

[0003] With recent progress of the control technology and enhancement of the performance of permanent magnets, the achievement of high rotations and high torque has become possible for the aforesaid motor. As a result, problems of connection accuracy between an output shaft of a rotor and a reduction gearing, coaxiality between an armature and a rotor, and heat radiation of a coil wound around the armature have become significant issues in satisfactorily securing the performance of the motor.

[0004] Under the circumstances described above, it is an object of the present invention to provide a motor which can provide output more efficiently and a method for producing the motor.

[0005] As the motor for the aforesaid running motor engine, there is proposed, for example, Japanese Patent Application Laid-Open Publication No. Hei 10-234158 which describes an electric motor including an armature, a rotor, a control section for controlling the armature and a motor casing for holding them.

[0006] Thus, the motor casing is configured to hold the control section together. Therefore, it is easy to secure an installing space and to mount the motor as compared with a design that the control section is separately provided.

[0007] The motor used for the aforesaid running motor engine or the like needs the motor casing to have airtightness in order to prevent water and dust from entering from outside.

[0008] But, because the motor casing which holds the armature, the rotor and the control section is generally configured by assembling a plurality of members respectively covering the armature, the rotor and the control section, it has many joints which are in contact with outside and, therefore, a disadvantage in securing airtightness.

[0009] In view of the aforesaid problems, it is an object of the present invention to provide a motor having the airtightness of the motor casing improved further more.

DISCLOSURE OF THE INVENTION

[0010] The invention described in claim 1 is a motor comprising an armature, a rotor and a motor casing for holding the armature and a bearing for the rotor, characterized by a reduction gearing consisting of a train of gears connected to an output shaft of the rotor and a reduction gearing casing for holding the reduction gearing, the motor casing being integrally provided with the reduction gearing casing, a hole, through which the output shaft is extended from the motor casing side to the reduction gearing casing side, being formed on a portion shared by these casings, and a lubrication oil filling the reduction gearing casing.

[0011] Thus, the motor of claim 1 has the reduction gearing consisting of the train of gears connected to the output shaft of the rotor and the reduction gearing casing for holding the reduction gearing, the motor casing is integrally provided with the reduction gearing casing, the hole, through which the output shaft being extended from the motor casing side to the reduction gearing casing side, formed on the portion shared by these casings, and the lubrication oil filling the reduction gearing casing. Therefore, the armature, the rotor, the bearing and the reduction gearing are accurately arranged, smoothness of the reduction gearing is secured by the lubrication oil, and power of the motor is obtained more efficiently.

[0012] If the motor casing and the reduction gearing casing have different bodies, the number of components increases, and the manufacturing cost rises. In addition, when the output shaft and the reduction gearing are mutually connected, their fitting positions and angles tend to have a subtle deviation, resulting in possible lowering of the power. But, the present invention avoids such problems without fail.

[0013] The invention described in claim 2 is the motor according to claim 1, wherein the bearing for the rotor and an oil seal for sealing the lubrication oil are placed in the hole, and the bearing is immersed in the lubrication oil.

[0014] In the motor of claim 2, the bearing for the rotor and the oil seal for sealing the lubrication oil are placed in the hole, and the bearing is immersed in the lubrication oil. Therefore, smoothness of the bearing for the rotor can be secured by the lubrication oil filling in the reduction gearing casing.

[0015] The invention described in claim 3 is a motor comprising an armature, a rotor and a motor casing for holding the armature and a bearing for the rotor, wherein the motor casing is configured by assembling a plurality of members, and at least one of the plurality of members supports the bearing and the inner diameter section of the armature.

[0016] Thus, in the motor of claim 3, the motor casing comprises the plurality of members assembled, and at least one of the plurality of members supports the bearing and the inner diameter section of the armature.

Therefore, the center axis of the armature and the center axis of the rotor can be aligned accurately, and power of the motor can be obtained more efficiently.

[0017] Specifically, when the plurality of members are assembled to form the motor casing, clearances and dimensional errors of the respective members are accumulated, possibly degrading coaxiality between the armature and the rotor and adversely effecting on the motor performance. But, such a drawback can be avoided without fail because at least one of the members of the present invention supports the bearing and the inner diameter part of the armature.

[0018] The invention described in claim 4 is a motor comprising an armature, a rotor and a motor casing for holding the armature and a bearing for the rotor, wherein a resin is charged into and cured in the motor casing to adhere to a coil of the armature and the inner surface of the motor casing.

[0019] Thus, according to the motor of claim 4, the resin is charged into and cured in the motor casing to adhere to the coil of the armature and the inner surface of the motor casing. Therefore, heat radiation of the coil of the armature can be secured sufficiently. As a result, power of the motor can be obtained more efficiently.

[0020] Especially, when the resin is provided to secure the heat radiation of the coil of the armature, a metal mold corresponding to the inner surface of the motor casing was conventionally used to form the resin around the coil of the armature, and the formed unit was fitted to the motor casing. Therefore, adhesion between the resin and the inner surface of the motor casing was poor, and its heat radiation was insufficient. Accordingly, the present invention charges the resin into the motor casing for curing it therein, so that the resin and the inner surface of the motor casing can be adhered securely, and heat radiation can be improved. And, the conventional metal mold is not needed to form the resin.

[0021] The invention described in claim 5 is a method for producing a motor comprising an armature, a rotor and a motor casing for holding the armature and a bearing for the rotor, comprises the step of: charging a resin into and curing in the motor casing to adhere the resin to a coil of the armature and the inner surface of the motor casing.

[0022] Thus, according to the method for producing the motor of claim 5, the resin is charged into and cured in the motor casing, to adhere to the coil of the armature and the inner surface of the motor casing, so that the heat radiation of the coil of the armature can be secured satisfactorily. As a result, power of the motor can be obtained more efficiently.

[0023] Especially, when the resin is disposed to secure the heat radiation of the coil of the armature, a metal mold corresponding to the inner surface of the motor casing was conventionally used to form the resin around the coil of the armature, and the formed unit was fitted to the motor casing. Therefore, adhesion between the resin and the inner surface of the motor casing was poor, and its heat radiation was insufficient. Accordingly, the present invention charges the resin into and cures it in the motor casing, so that the resin and the inner surface of the motor casing can be adhered more securely, and heat radiation can be improved. And, the conventional metal mold is not needed to form the resin.

[0024] The invention described in claim 6 is the method for producing a motor according to claim 5, wherein when the resin is charged into the motor casing, a core for securing a space for placing the rotor is inserted into the motor casing.

[0025] Thus, the method for producing the motor of claim 6 charges the resin into the motor casing with the core for securing the space, in which the rotor is disposed, inserted into the motor casing, so that the rotor and the resin can be disposed efficiently.

[0026] The invention described in claim 7 is the method for producing a motor according to claim 6, wherein the motor is provided with a rotation sensor for detecting a rotation position of the rotor, and the core secures a space for placing the rotation sensor.

[0027] As described above, according to the method for producing the motor of claim 7, the motor is provided with the rotation sensor for detecting a rotation position of the rotor, and the core secures the space for disposing the rotation sensor. Thus, the rotation sensor can be disposed efficiently.

[0028] The invention described in claim 8 is a motor comprising an armature, a rotor, a control section for controlling the armature and a motor casing for holding them, wherein the motor casing includes a first casing member and a second casing member which cover the armature and the rotor and are respectively provided with bearings for the rotor and a third casing member for covering the control section, the first casing member and the third casing member are assembled to form an outer shell of the motor, the first casing member and the second casing member are assembled to divide the inside of the motor, and seating surfaces to be mutually contacted are respectively formed on ends of the first casing member and the third casing member.

[0029] According to the motor of claim 8, airtightness of the motor casing is improved further more.

[0030] Specifically, the motor casing for holding the armature, the rotor and the control section is configured by assembling a plurality of members which respectively cover the armature, the rotor and the control section, so that there are many joints which are exposed to outside, and it is disadvantageous in view of securing airtightness. In the present invention, however, the joint between the first casing member and the second casing member is located inside the joint between the first casing member and the third casing member, so that airtightness can be secured relatively easily.

[0031] And, the first casing member and the third casing member can be assembled accurately by virtue of the seating surfaces respectively formed thereon, and a gap in the joint can be eliminated without fail.

[0032] The invention described in claim 9 is the motor according to claim 8, wherein a through section is disposed on the second casing member through which to pass the wiring for connecting the armature with the control section.

[0033] According to the motor of claim 9, the wiring for connecting the armature and the control section within the motor casing can be arranged efficiently.

[0034] The invention described in claim 10 is the motor according to claim 8 or 9, wherein a substrate of the control section is supported by the second casing member.

[0035] According to the motor of claim 10, the control section can be arranged efficiently in the motor casing.

[0036] The invention described in claim 11 is the motor according to any of claims 8 to 10, wherein a sensor for detecting a position of the rotor is supported by the second casing member.

[0037] According to the motor of claim 11, the sensor for detecting a position of the rotor can be disposed efficiently in the motor casing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038]

Fig. 1 is a sectional view showing a motor according to an embodiment of the present invention;
Fig. 2 is a sectional view showing important portions of a motor casing and an armature according to the embodiment of the present invention;
Fig. 3 is a sectional view showing a motor according to an embodiment of the present invention;
Fig. 4 is a sectional view showing a motor according to the embodiment of the present invention;
Fig. 5 is a sectional view showing a motor according to an embodiment of the present invention;
Fig. 6 is an explanatory diagram showing a method for producing a motor according to the embodiment of the present invention;
Fig. 7 is a side view showing a motor according to an embodiment of the present invention;
Fig. 8 is a side sectional view showing a motor according to the embodiment of the present invention; and
Fig. 9 is a front view showing a first casing member and a second casing member according to the embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0039] Embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0040] As shown in Fig. 1, a motor 1 of this embodiment is a DC brushless motor configuring a motor engine for vehicles and comprises an armature 2, a rotor 3 which rotates inside the armature 2, a motor casing 5 which holds the armature 2 and bearings 4, 4 for the rotor 3, a reduction gearing 6 consisting of a train of gears and connected to an output shaft 3a of the rotor 3, and a reduction gearing casing 7 for holding the reduction gearing 6. In the drawing, 2a indicates a coil wound around the armature 2.

[0041] The motor 1 has an unillustrted battery as its power source, and it is configured that its output shaft 3a has the number of revolutions of about 100,00 [rpm] and can output torque of about nine [Newton] by controlling a weak field.

[0042] As shown in the same drawing, the motor casing 5 and the reduction gearing casing 7 are integrally formed, and a portion shared by these casings is provided with a hole 8 through which the output shaft 3a extends from the motor casing 5 side to the reduction gearing casing 7 side. And, lubrication oil 9 filling the reduction gearing casing 7.

[0043] The reduction gearing 6 is configured by providing a plurality of mutually meshed gears, and its output portion 6a is protruded from an essential portion of the reduction gearing casing 7 where an oil seal 10' is placed to seal the lubrication oil 9. Smoothness of the reduction gearing 6 can be secured by the lubrication oil 9.

[0044] The motor casing 5 and the reduction gearing casing 7 are configured by bolting a pair of members 5a, 5a, which form a cylindrical interior, with a member 7a which is fitted to the members 5a, 5a.

[0045] As shown in Fig. 2, the armature 2 is fitted between stepped portions A and A which are respectively formed on the pair of members 5a, 5a.

[0046] One of the bearings 4, 4 for the rotor 3 and an oil seal 10 for sealing the lubrication oil 9 are disposed in the hole 8, and this bearing 4 is immersed in the lubrication oil 9. The other bearings 4, 4 are respectively disposed in appropriate positions of the motor casing 5 and the reduction gearing casing 7, and these in the motor casing 5 are greased for lubrication.

[0047] Specifically, the bearing 4 placed in the hole 8 receives a relatively large load when torque is transmitted, so that it is designed to be somewhat larger than the other bearings 4, 4 and immersed in the lubrication oil 9 so to operate smoothly.

[0048] As described above, the motor of this embodiment has the reduction gearing consisting of the train of gears and connected to the output shaft of the rotor and the reduction gearing casing for holding the reduction gearing, the motor casing and the reduction gearing casing are integrally formed, the hole is formed on the portion shared by these casings, through which the output shaft extends from the motor casing side to the reduction gearing casing side, and the lubrication oil is filling in the reduction gearing casing. Thus, the armature, the rotor, the bearing and the reduction gearing can be disposed accurately, smoothness of the reduction gearing and the bearings can be secured by the lubrication oil, and the motor output can be obtained more efficient-

ly.

[0049] If the motor casing and the reduction gearing casing are separate bodies, the number of components increases, resulting in the increase of manufacturing costs. And, when the output shaft and the reduction gearing are mutually connected, their mounting positions and angles tend to be slightly misaligned. Thus, power might be lowered, but such drawbacks can be avoided by this embodiment without fail.

[0050] In the motor of this embodiment, the bearing for the rotor and the oil seal for sealing the lubrication oil are disposed in the hole, and the bearing is immersed in the lubrication oil. Accordingly, smoothness of the bearing for the rotor can be secured by the lubrication oil which fills in the reduction gearing casing.

[0051] Then, a second embodiment of the present invention will be described with reference to Fig. 3 and Fig. 4. This motor has the same basic structure as that of the motor described in the aforesaid embodiment, so that like reference numerals are used for the common members, and their descriptions are omitted.

[0052] As shown in Fig. 3, the motor casing 5 of this embodiment comprises a plurality of members 5a, 5a which are assembled, and the members 5a, 5a are configured to support the bearing 4 and the inner diameter part of the armature 2.

[0053] Specifically, the bearing 4 and the inner diameter part of the armature 2 are respectively positioned with respect to the respective members 5a, 5a configuring the motor casing 5. As a result, the center axis of the armature 2 and the center axis of the rotor 3 are aligned accurately.

[0054] A reduction gearing may be fitted to the output shaft 3a of the rotor 3 in the same way as in the aforesaid embodiment.

[0055] Fig. 3 shows an example that the armature 2 is thoroughly housed in the motor casing 5, but as shown in Fig. 4, the outer diameter part of the armature 2 may be exposed to the outside of the motor casing 5. The motor casing 5 shown in Fig. 4 is assembled by having the leading ends of bolts 5b and 5b, which are inserted through one of the members 5a, 5a, screwed with the other member 5a.

[0056] As described above, in the motor of this embodiment, the motor casing is configured by assembling a plurality of members, and at least one of the plurality of members supports the bearing and the inner diameter part of the armature. Therefore, the center axis of the armature and the center axis of the rotor can be aligned accurately, and power of the motor can be obtained more efficiently.

[0057] In other words, when the plurality of members are assembled to form the motor casing, clearances and dimensional errors of the respective members are accumulated, possibly degrading the coaxiality between the armature and the rotor and adversely effecting on the motor performance. But, such drawbacks can be avoided without fail because at least one of the members of this embodiment supports the bearing and the inner diameter part of the armature.

[0058] Then, a third embodiment of the present invention will be described with reference to Fig. 5 and Fig. 6. This motor has the same basic structure as that of the motor described in the aforesaid embodiment. Therefore, like reference numerals are used for the common members, and their descriptions are omitted.

[0059] As shown in Fig. 5, the motor 1 of this embodiment has a resin 11 charged into and cured in the motor casing 5 so to adhere the resin 11 to the coil 2a of the armature 2 and the inner surface of the motor casing 5. In the drawing, 12 indicates a rotation sensor for detecting a rotation position of the rotor 3.

[0060] The resin 11 is preferably to be a resin capable of improving heat radiation of the coil 2a. Specifically, silicon based resin or epoxy based resin, which is a high heat conductive and uncured hardening resin, is optimum. As the silicon based resin, commercially available two-part silicon potting agents (e.g., Three Bond 1230 etc. manufactured by Three Bond Co., Ltd.) are Suitable. And, as the epoxy based resin, a one-can epoxy-blended resin (e.g., Three Bond 2200 Series etc. manufactured by Three Bond Co., Ltd.) is suitable.

[0061] For the two-part silicon potting agent, a silicon resin and a hardening agent are generally provided separately. Therefore, the silicon potting agent cures at room temperature by mixing the silicon resin and the curing agent immediately before charging them into the motor casing 5. By appropriately heating as required, hardening time can be decreased, and hardening and adhesion can be effected more efficiently.

[0062] On the other hand, the one-can epoxy-blended resin has a relatively low viscosity, so that it can be adhered to the inner surface of the motor casing 5 by charging it into the motor casing 5 and heat hardening.

[0063] The resin used in this embodiment has been described with reference to the two types of resins as above. It is to be understood, however, that the resins used by the invention are not limited to the aforesaid resins but other appropriate resins may be used.

[0064] To charge the resin 11 into the motor casing 5, a core 13 for securing a space, in which the rotor 3 and the rotation sensor 12 are disposed, is inserted into the motor casing 5 as shown in Fig. 6.

[0065] The resin 11 is charged through a hole 14 formed on the motor casing 5 as indicated by an arrow in the same drawing. This hole is formed by one or two or more at appropriate positions.

[0066] And, the rotor 3, the rotation sensor 12 and one of the members 5a configuring the motor casing 5 are disposed after curing the resin 11 and removing the core. The member 5a disposed here closes an opening for putting in and out of the core 13, and especially the bearing 4 for the rotor 3 is disposed in it, and the output shaft 3a of the rotor 3 is placed through it.

[0067] The reduction gearing may be mounted to the output shaft 3a of the rotor 3 as described in the afore-

said embodiment. And, the same resin as used in the aforesaid embodiment may be used.

[0068] As described above, in the motor of this embodiment, the resin is charged into and cured in the motor casing to adhere to the coil of the armature and the inner surface of the motor casing. Therefore, the heat radiation of the coil of the armature can be secured satisfactorily. As a result, power of the motor can be obtained more efficiently.

[0069] Especially, when the resin is disposed to secure the heat radiation of the coil of the armature, a metal mold corresponding to the inner surface of the motor casing was conventionally used to form the resin around the coil of the armature, and the formed unit was fitted to the motor casing. Therefore, adhesion between the resin and the inner surface of the motor casing was poor, and its heat radiation was insufficient. Therefore, this embodiment charges the resin into and cures it in the motor casing, so that the resin and the inner surface of the motor casing can be adhered securely, and heat radiation can be improved. And, the conventional metal mold is not needed to form the resin.

[0070] According to the method for producing the motor of this embodiment, the resin is charged into and cured in the motor casing to adhere the resin to the coil of the armature and the inner surface of the motor casing, so that the heat radiation of the coil of the armature can be secured satisfactorily. As a result, power of the motor can be obtained more efficiently.

[0071] Besides, according to the method for producing the motor of this embodiment, to charge the resin into the motor casing, the core for securing the space, in which the rotor is disposed, is inserted into the motor casing, so that the rotor and the resin can be disposed efficiently.

[0072] In addition, according to the method for producing the motor of this embodiment, the motor is provided with a rotation sensor for detecting a rotation position of the rotor, and the core secures the space for disposing the rotation sensor. Thus, the rotation sensor can be disposed efficiently.

[0073] Then, a fourth embodiment of the present invention will be described in detail with reference to the drawings.

[0074] As shown in Fig. 7 to Fig. 9, the motor 1 of this embodiment is a DC motor or DC brushless motor, which is used for a motor engine for running and comprises the armature 2, the rotor 3 and a control section 40 for controlling the armature 2 held in the motor casing 5.

[0075] The armature 2 is provided around the rotor 3 with a small space between them, and the rotor 3 is rotated around an output shaft 310 supported by a bearing 320 when commutation is caused in a coil 210 of the armature 2 by the control section 40.

[0076] The motor casing 5 of this embodiment comprises a plurality of casing members formed of aluminum alloy or hard resin, and has a first casing member 510 and a second casing member 520 which cover the armature 2 and the rotor 3 with the bearing 320 respectively disposed, and a third casing member 530 for covering the control section 40.

[0077] And, the outer shell of the motor 1 is configured by assembling the first casing member and the third casing member, and its inside is divided by assembling the first casing member and the second casing member.

[0078] In this embodiment, the respective casing members 510, 520, 530 are assembled by screwing.

[0079] In the drawings, 540 indicates a turn stop member for preventing the first casing member 510 and the second casing member 520 from displacing.

[0080] Specifically, the motor 1 is formed by fitting the armature 2 having a substantially cylindrical shape into the first casing member 510, disposing the armature 3 at its center, screwing the first casing member 510 and the second casing member 520, disposing the control section 40 between the second casing member 520 and the third casing member 530, and screwing the first casing member 510 and the third casing member 530.

[0081] Coaxiality between the armature 2 and the rotor 3 is accurately maintained when the armature 2 is held in position between the first casing member 510 and the second casing member 520 and the output shaft 310 of the rotor 3 is supported by the bearings 320 disposed in the first casing member 510 and the second casing member 520.

[0082] The output shaft 310 of the rotor 3 is exposed from an opening 512 of the first casing member 510 and connected to outside.

[0083] And, seating surfaces 511, 531 which are designed to contact mutually are respectively formed on the ends of the first casing member 510 and the third casing member 530.

[0084] The seating surfaces 511, 531 are perpendicularly formed with respect to a direction is which the first casing member 510 and the third casing member 530 are screwed so to be mutually attached by pressure. Therefore, airtightness of the motor casing 5 can be secured without fail.

[0085] To secure the airtightness of the motor casing 5 more reliably, a groove or a stepped portion may be formed on the respective seating surfaces 511, 531 to mount a gasket, an 0-ring or the like.

[0086] For the heat radiation of the motor 1, fins 501 for heat radiation are formed at appropriate positions of the casing 5, and a resin material 220 is placed around the coil 210 of the armature 2 to fill a space between the armature 2 and the casing 5. The resin material 220 is solidified to shape by using a predetermined metal mold. Otherwise, it may be designed to form by injecting the resin into the casing 5 without using a metal mold. The resin material may be the same one as used in the aforesaid embodiment.

[0087] The control section 40 of this embodiment comprises a control circuit 410 to output a control signal according to an instruction transmitted from outside and

a drive circuit 420 for supplying power to the armature 2 according to the control signal. The control circuit 410 is mounted on a substrate 411 supported by the second casing member 520, and the drive circuit 420 is mounted on a substrate 421 supported by the third casing member 530.

[0088] Wiring 60 for connecting the armature 2 with the drive circuit 421 of the control section 40 is passed through a notched through section 521 provided on the second casing member 520.

[0089] A plurality of projections 522 for supporting the substrate 411 of the control circuit 410 are formed on the second casing member 520, and the substrate 411 is supported by being screwed to the respective projections 522.

[0090] Besides, the control circuit 410 is connected to a sensor 70 for detecting a position of the rotor 3, and a control signal is output according to the position of the rotor 3 detected by the sensor 70. The sensor 70 has a ring shape to be inserted over the output shaft 310 of the rotor 3 and screwed to the second casing member 520.

[0091] As described above, in the motor of this embodiment, the motor casing has the first casing member and the second casing member for covering the armature and the rotor and respectively provided with the bearing for the rotor and the third casing member for covering the control section. The first casing member and the third casing member are assembled to form the outer shell of the motor, and the first casing member and the second casing member are assembled to divide the inside of the motor. And, the seating surfaces which are designed to contact mutually are respectively formed on the ends of the first casing member and the third casing member, so that the airtightness of the motor casing can be improved further more.

[0092] Specifically, the motor casing for holding the armature, the rotor and the control section is configured by assembling a plurality of members which respectively cover the armature, the rotor and the control, so that there are many joints which are exposed to outside, and it is disadvantageous in view of securing airtightness. In this embodiment, however, the joint between the first casing member and the second casing member is located inside of the joint between the first casing member and the third casing member, so that airtightness can be secured relatively easily.

[0093] And, the first casing member and the third casing member can be assembled accurately by virtue of the seating surfaces respectively formed thereon, and a gap in the joint can be eliminated completely.

[0094] Besides, in the motor of this embodiment, the through section, through which the wiring for connecting the armature and the control section is passed through, is placed in the second casing member, so that the wiring for connecting the armature and the control section within the motor casing can be disposed efficiently.

[0095] In addition, in the motor of this embodiment, the substrate of the control section is supported by the second casing member, so that the control section can be arranged efficiently in the motor casing.

[0096] Furthermore, in the motor of this embodiment, the sensor for detecting a position of the rotor is supported by the second casing member, so that the sensor for detecting a position of the rotor can be disposed efficiently in the motor casing.

INDUSTRIAL APPLICABILITY

[0097] The present invention can improve connection accuracy of the output shaft of the rotor with the reduction gearing, the coaxiality between the armature and the rotor, and the heat radiation of the coil wound around the armature in a motor of high rotations and high torque, and it is especially suitable as a motor for electric vehicles.

Claims

1. A motor comprising an armature, a rotor and a motor casing for holding the armature and bearings for the rotor,
   characterized by:

   reduction gearing consisting of a train of gears connected to an output shaft of the rotor and a reduction gearing casing for holding the reduction gearing, the motor casing being integrally provided with the reduction gearing casing, a hole, through which the output shaft is extended from the motor casing side to the reduction gearing casing side, being formed on a portion shared by these casings, and a lubrication oil filling the reduction gearing casing.

2. The motor according to claim 1, wherein the bearing for the rotor and an oil seal for sealing the lubrication oil are placed in the hole, and the bearing is immersed in the lubrication oil.

3. A motor comprising an armature, a rotor and a motor casing for holding the armature and bearings for the rotor, wherein:

   the motor casing is configured by assembling a plurality of members, and at least one of the plurality of members supports the bearing and the inner diameter section of the armature.

4. A motor comprising an armature, a rotor and a motor casing for holding the armature and bearings for the rotor, wherein:

   a resin is charged into and cured in the motor casing to adhere to a coil of the armature and

the inside surface of the motor casing.

5. A method for producing a motor comprising an armature, a rotor and a motor casing for holding the armature and bearings for the rotor, comprising the step of:

   charging a resin into and curing in the motor casing to adhere the resin to a coil of the armature and the inner surface of the motor casing.

6. The method for producing a motor according to claim 5, wherein when the resin is charged into the motor casing, a core for securing a space for placing the rotor is inserted into the motor casing.

7. The method for producing a motor according to claim 6, wherein the motor is provided with a rotation sensor for detecting a rotation position of the rotor, and the core secures a space for placing the rotation sensor.

8. A motor comprising an armature, a rotor, a control section for controlling the armature and a motor casing for holding them, wherein:

   the motor casing includes a first casing member and a second casing member which cover the armature and the rotor and are respectively provided with bearings for the rotor and a third casing member for covering the control section, the first casing member and the third casing member are assembled to form an outer shell of the motor, the first casing member and the second casing member are assembled to divide the inside of the motor, and seating surfaces to be mutually contacted are respectively formed on ends of the first casing member and the third casing member.

9. The motor according to claim 8, wherein a through section is provided on the second casing member, through which wiring for connecting the armature with the control section is passed.

10. The motor according to claim 8 or 9, wherein a substrate of the control section is supported by the second casing member.

11. The motor according to any of claims 8 to 10, wherein a sensor for detecting a position of the rotor is supported by the second casing member.

Fig. 1

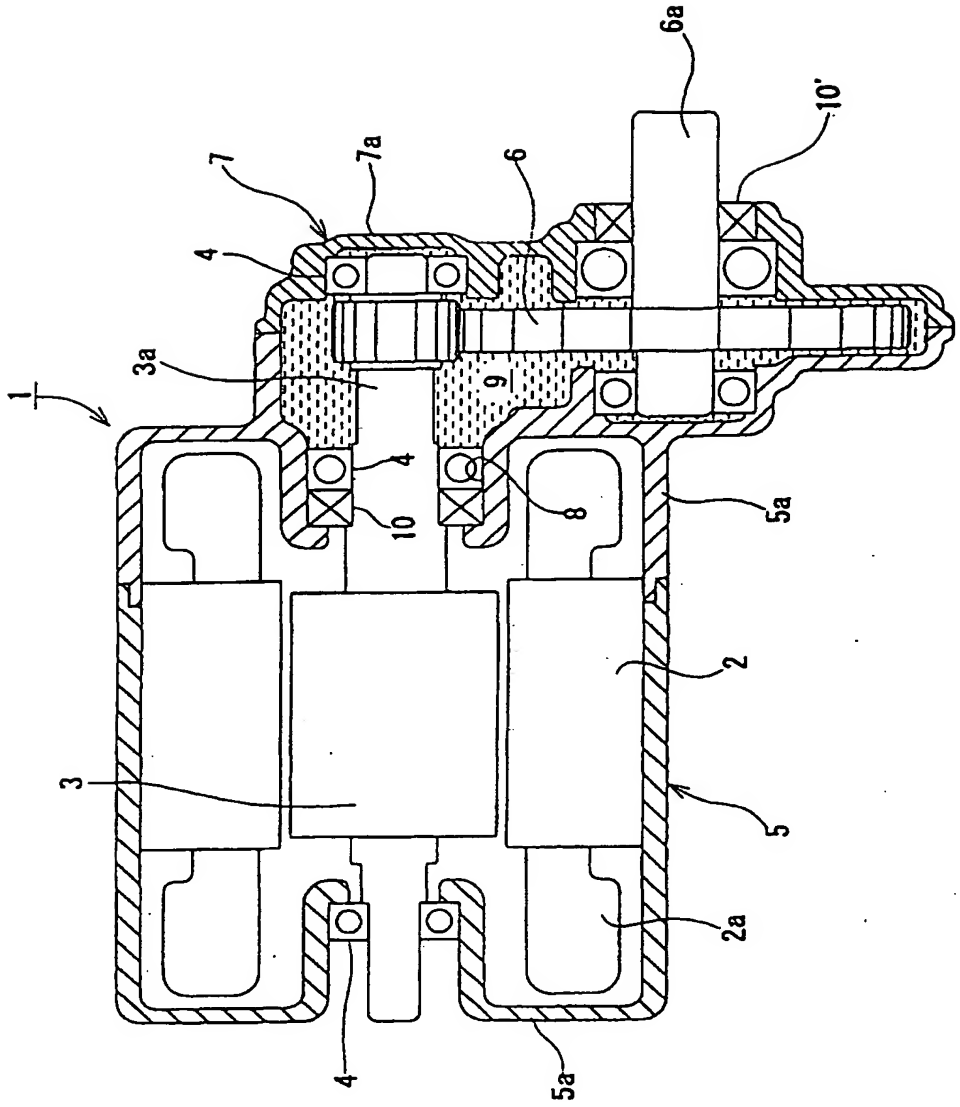


Fig. 2

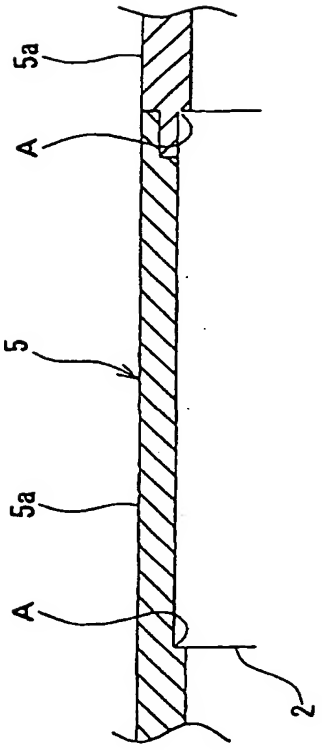


Fig. 3

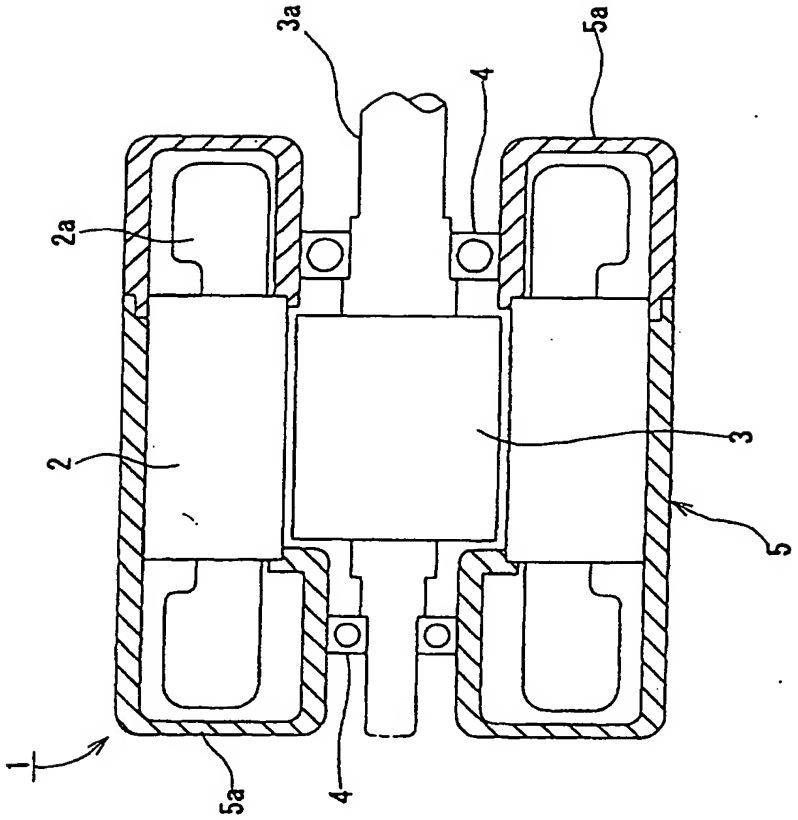


Fig. 4

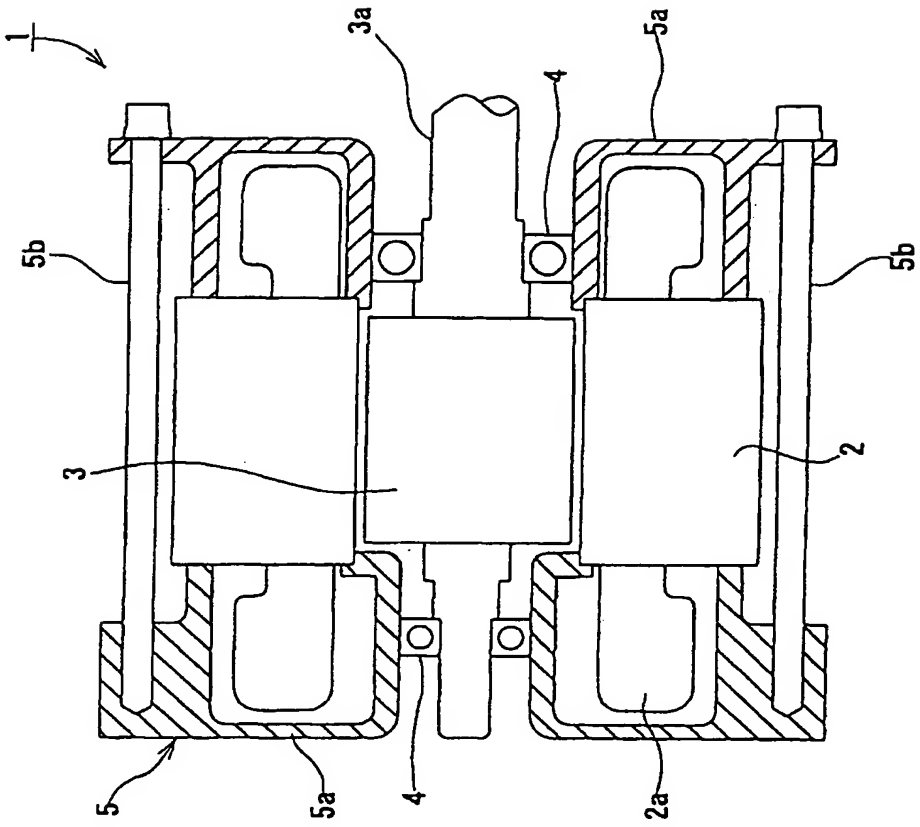


Fig. 5

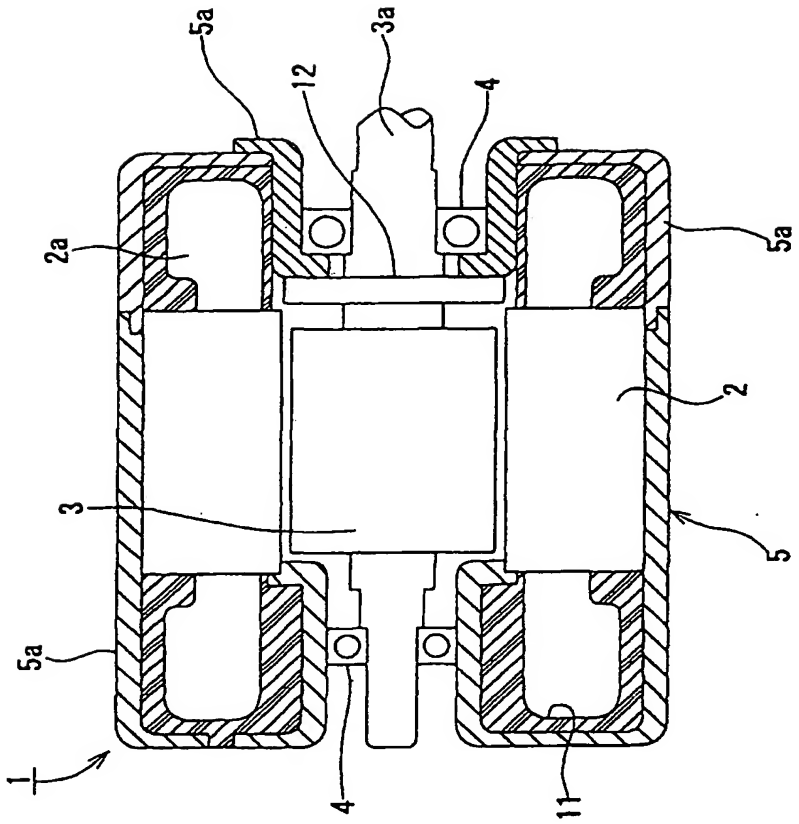


Fig. 6

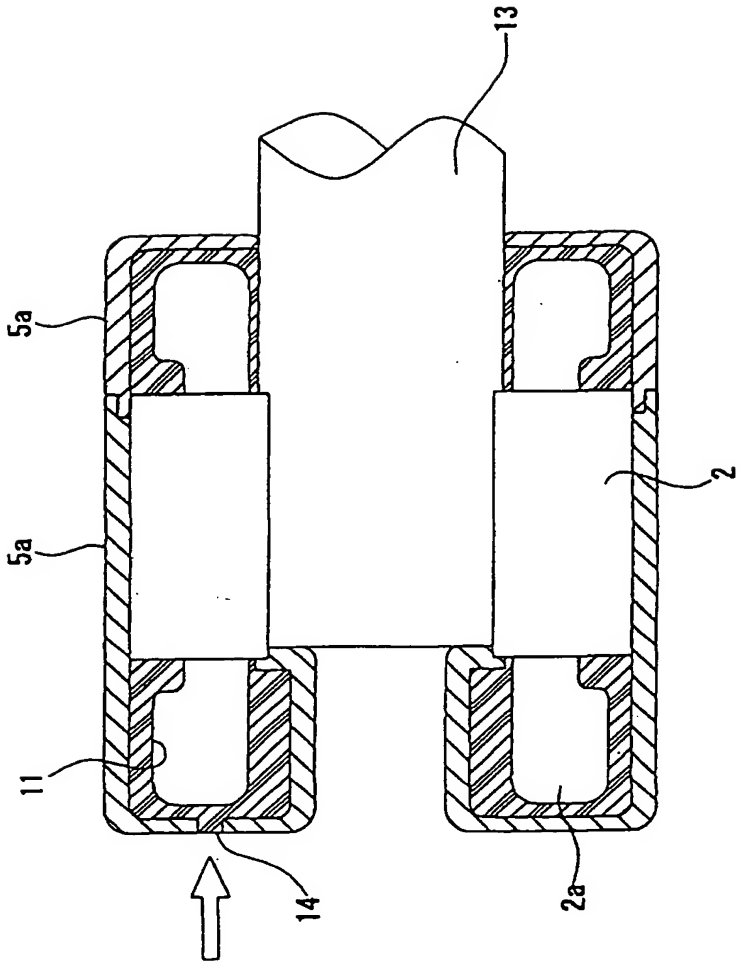


Fig. 7

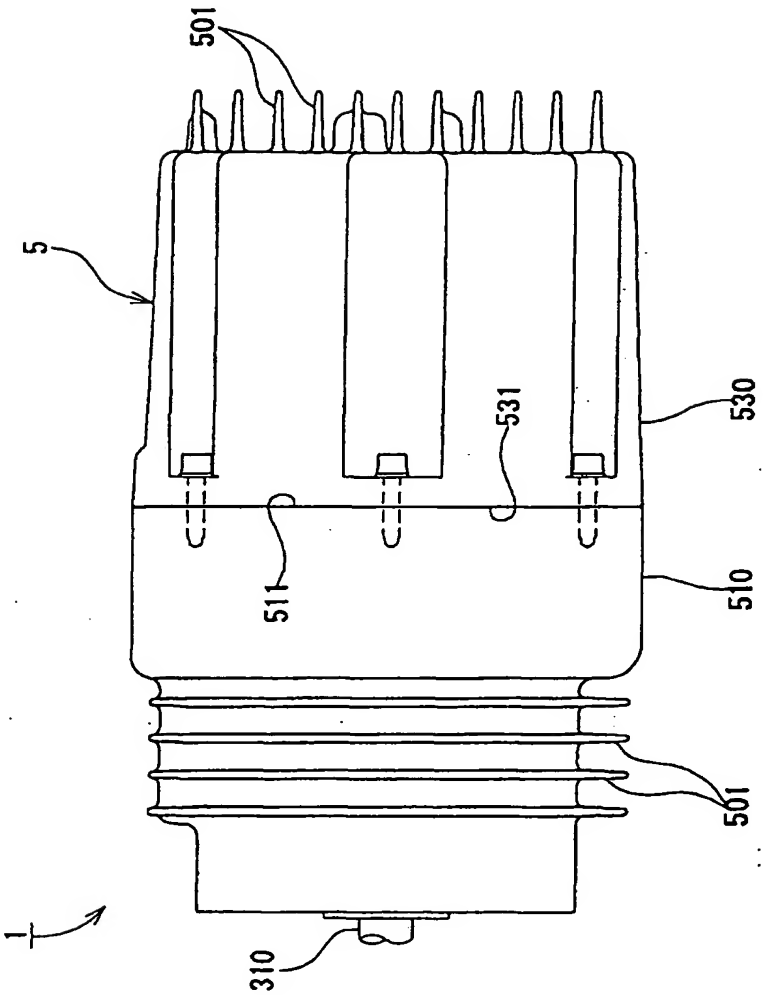
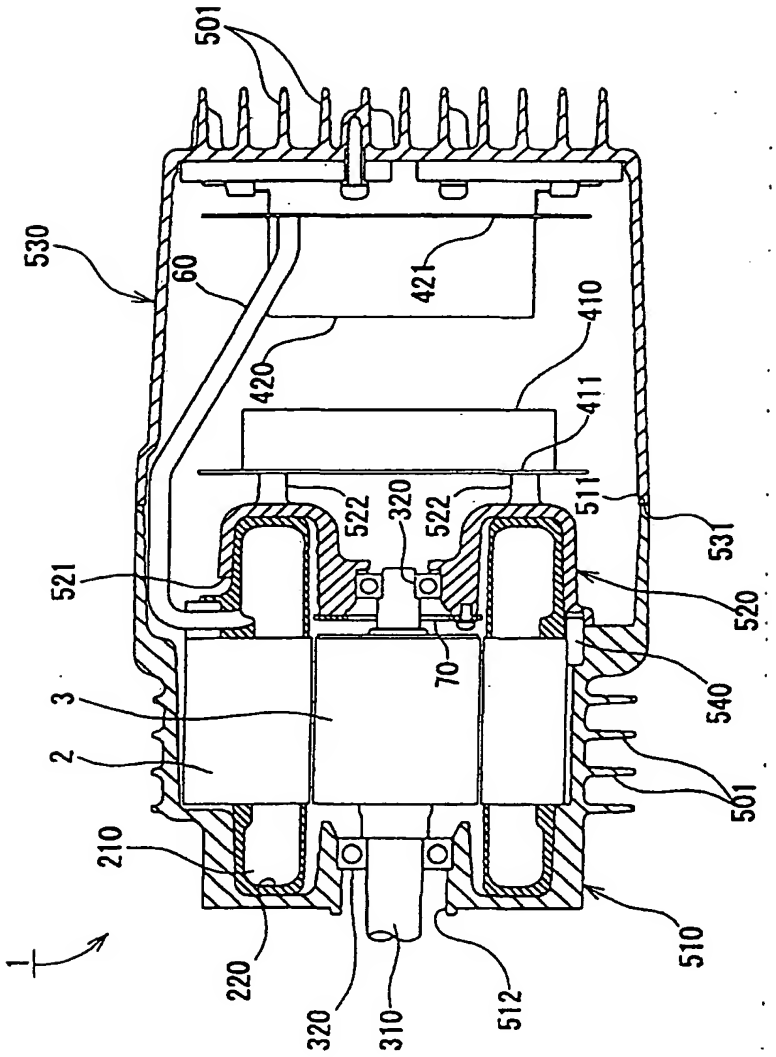


Fig. 8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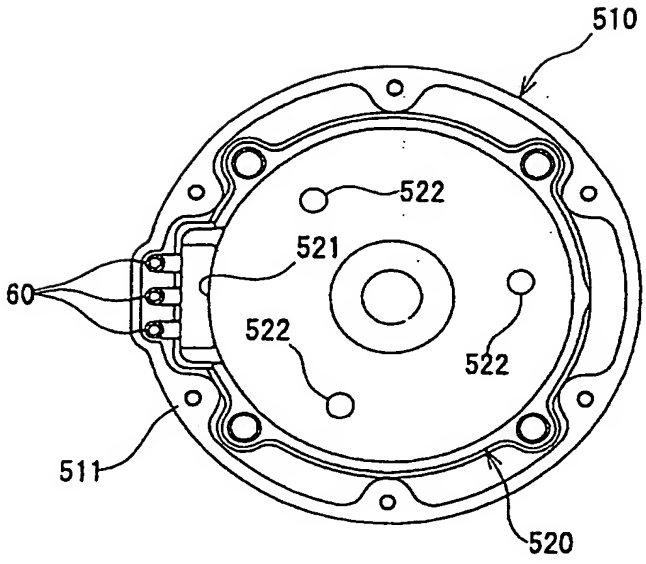
512

Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/04771

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H02K7/116, H02K5/04, H02K5/124, H02K29/00, H02K3/24, H02K3/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H02K7/116, H02K5/04, H02K5/124, H02K29/00, H02K3/24, H02K3/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 2-88450, U (Matsushita Electric Ind. Co., Ltd.), 12 July, 1990 (12.07.90), Full text; Figs. 2, 5 (Family: none)	1,2
X	JP, 57-160347, A (Tokyo Shibaura Denki K.K.), 02 October, 1982 (02.10.82), Full text; Figs. 1 to 4 (Family: none)	3
X Y	JP, 10-322959, A (Ebara Corporation, et al.), 04 December, 1998 (04.12.98), Full text; Figs. 1 to 3 (Family: none)	4,5,6 7
Y	JP, 10-201168, A (Toshiba Corporation), 31 July, 1998 (31.07.98), Full text; Figs. 1 to 14 (Family: none)	7
X	JP, 8-84451, A (Copal Electron Co., Ltd.), 26 March, 1996 (26.03.96), Full text; Figs. 1 to 5 (Family: none)	8-11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 October, 2000 (25.10.00)	28 November, 2000 (28.11.00)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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